

Rocky Flats Environmental Technology Site

4-I54-ENV-OPS-FO.36

REVISION 0

ION EXCHANGE SYSTEM REGENERATION OPERATIONS OPERABLE UNIT 1, BUILDING 891

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1. PURPOSE

This procedure provides operating instructions for the regeneration of ion exchange (IX) resins at the Building 891 Groundwater Treatment Facility for 881 Hillside, Operable Unit 1, at the Rocky Flats Environmental Technology Site.

2. SCOPE

This procedure applies to all Environmental Operations Management (EOM) employees and subcontractors.

This procedure addresses the following topics:

- Automatic IX regeneration operation
- Manual IX regeneration operation

3. OVERVIEW

The Building 891 Groundwater Treatment Facility consists of a groundwater recovery and storage system, an ultraviolet/hydrogen peroxide oxidation system, an IX system with units for acid and caustic regeneration of resin, a spent regenerant neutralization system, and a treated effluent storage and discharge system. A simplified diagram of the Building 891 Groundwater Recovery/Storage system is shown in Appendix 1, Groundwater Recovery/Storage System Diagram. A listing of valve designators, nomenclature, and type is provided in Appendix 2, Valves.

The IX system is designed to remove the following:

- Uranium
- Alkalinity
- Hardness
- Metals
- Total dissolved solids
- Chlorides
- Sulfates
- Nitrates
- Nitrites

A periodic regeneration for resins may be necessary for the system to continue the ion removal treatment. Under normal operating conditions, the Allen Bradley touch screen automatically cycles through the following steps once the regeneration is initiated by the Operator.

3.1 **Backwash**

Backwashing removes the fine suspended solids and media fines that may accumulate on the top of the IX resin beds by a flow of clean water which is the reverse of the normal processing flow path, for example, upflow through the bed. Backwash flow rates are based on the desired bed expansion. The source of the water used for backwashing is T-204, a 15,000-gal Clean Water Tank. Centrifugal Pump, P-3 is used to supply the desired flow to the appropriate IX column.

3.2 **Regeneration**

Regeneration of the strong acid (IX-3) and weak acid (IX-2) columns occurs in a series operation. A hydrochloric acid (HCl) solution is pumped through the strong acid column to the weak acid column. The columns may also be regenerated separately. The spent regenerant is collected in T-210, the Neutralization Tank. The dilute HCl solution is prepared in-line by metering an amount of concentrated HCl from T-209, the bulk HCl Storage Tank, with a metering pump into the stream of clean water pumped from the Clean Water Tank, T-204.

Regeneration of the weak base (IX-4) column is accomplished using sodium hydroxide (NaOH) diluted from 50% NaOH. The spent regenerant is collected in T-210. The dilute NaOH solution is prepared by pumping a metered amount of the concentrated NaOH from T-208, the Bulk NaOH Storage Tank, with a metering pump into a stream of clean water from T-204.

3.3 **Slow Rinse**

The slow rinse is a rinse with clean water which follows the normal processing flow path, for example, downflow through the bed. The volume of the slow rinse is one to two bed volumes, and displaces the acid or caustic residing from regeneration in the following IX systems:

- IX-2
- IX-3
- IX-4

The slow rinse water and displaced regenerant is recovered in T-210.

3.4 **Fast Rinse**

Fast rinse is a rinse with clean water that follows the normal process flow path, downflow through the bed, to remove trace acid and caustic levels before placing one of the following regenerated IX columns back into service:

- IX-2
- IX-3
- IX-4

The fast rinse water is drawn from and returned to T-204.

3.5 Neutralization System

T-210 is a 5,076-gal tank for neutralization and storage of spent regenerant. The system uses the bulk HCl from T-209 and NaOH from T-208 to neutralize the pH of the contents of T-210 before transferring the contents to the tank trailers for transport to the Building 374 Evaporator.

4. RESPONSIBILITIES

4.1 Operator

Operates the automatic and manual IX regeneration operations.

4.2 Project Manager

Ensures that all personnel, including subcontractors, are trained and qualified to perform the duties, tasks, and responsibilities described in this procedure.

5. LIMITATIONS AND PRECAUTIONS

- The tanks and IX vessels associated with the IX regeneration system are confined spaces. Entry to the tanks or vessels shall be in accordance with Rocky Flats procedures and the Rocky Flats Plant Operable Unit 1 Groundwater Treatment Facility Health and Safety Plan.
- The regeneration system uses concentrated acid and base solutions for regeneration of the IX columns. Use and handling of these materials shall be in accordance with the requirements of the Rocky Flats Plant Operable Unit 1 Groundwater Treatment Facility Health and Safety Plan.
- This procedure covers normal regeneration operations of the IX system. Any problems with the regeneration cycle encountered during operations shall be reported immediately to EOM personnel and resolved through the use of the troubleshooting information contained in the Bruner Ion Exchange Manual maintained at the facility.

6. PREREQUISITES

6.1 Planning and Coordination

Project Manager

- [1] Ensure that all personnel performing these procedures have the appropriate health and safety training as specified in the Rocky Flats Plant Operable Unit 1 Groundwater Treatment Facility Health and Safety Plan.
- [2] Document personnel qualifications related to this procedure in the project files in accordance with 2-F94-ER-ADM-02.01, Training.

6.2 Material and Equipment

6.2.1 Measuring and Test Equipment

Operator

- [1] Ensures that the following equipment is available:
- Hydrometer and sampling container for measuring specific gravity of 1.0279.
 - Hydrometer and sampling container for measuring specific gravity of 1.0428.

6.2.2 Special Tools and Equipment

Operator

- [1] Ensures that a bucket is available for use in neutralizing acid and caustic samples.

6.2.3 Consumables

Operator

- [1] Ensures that dry neutralizer is available.

7. INSTRUCTIONS

When the IX system is no longer capable of removing the inorganic materials, as noted by final pH or head loss, the resin has to be regenerated.

Conditions requiring regeneration include a treatment volume of 56,500 gal treated or effluent pH from column IX-4 less than 6. IX-3 is regenerated with HCl, and the used HCl is used to regenerate column IX-2. NaOH is used to regenerate column IX-4. Regeneration is normally completed automatically when the IX columns are backwashed and regenerated through 17 pre-programmed steps by the Programmable Logic Controller. The 17 pre-programmed steps are detailed in Appendix 3, Regeneration Schedule and in Appendix 4, Detailed Regeneration Schedule.

NOTE 1 *If the bag filter preceding column IX-1 exceeds a pressure of 12 psi, the IX system shuts down automatically.*

NOTE 2 *IX-1 does not require regeneration but is bump-rinsed one for every five system regeneration cycles.*

NOTE 3 *Conductivity and pH are monitored on the IX Control Panel.*

7.1 IX Regeneration Operation—Automatic

Project Manager and Operator

- [1] Document all activities on the Daily Log in accordance with 2-G18-ER-ADM-17.01, Records Capture and Transmittal.

Project Manager

- [2] Verify that all prerequisites in Section 6, Prerequisites have been completed and record on Daily Log.

Operator

- [3] Verify that T-210 is empty before starting regeneration.
 - [A] Observe indicated level on Allen Bradley screen.
 - [B] Observe level in tank sight glass.
- [4] Ensure that the water level in T-204 is approximately 6 ft (5.50 to 7.70 ft).
 - [A] Observe indicated level on Allen Bradley screen.

7.1 IX Regeneration Operation—Automatic (continued)

Operator (continued)

NOTE *Appendix 5, Valve Positioning may be used as check sheet for following step.*

- [5] Ensure that the following valves are OPEN:
- V-18, IX-1 Subsurface Backwash Inlet
 - V-17, IX-2 Subsurface Backwash Inlet
 - V-23, Caustic Makeup Water
 - V-24, Acid Makeup Water
 - V-15, P-3 Inlet
 - V-16, P-3 Outlet
 - V-19, IX-3 Subsurface Backwash Inlet
 - V-20, IX-4 Subsurface Backwash Inlet
 - V-21, Bag Filter #2 Inlet
 - V-22, Bag Filter #2 Outlet
 - V-27, P-5 Service Outlet
 - V-28, P-4 Service Outlet
 - V-29, P-5 Service Inlet
 - V-30, P-4 Service Inlet
 - V-31, T-208 Outlet
 - V-32, T-209 Outlet
 - V-47, IX-2 Acid Regenerant
 - V-48, IX-3 Acid Regenerant
 - V-49, IX-4 Caustic Regenerant
 - V-65, Caustic Dilution Water Flow Control
 - V-66, Acid Dilution Water Flow Control
 - V-67, Caustic Pressure
 - V-68, Acid Pressure

“FV” valves shown in Appendix 5 open and close automatically in each step.

NOTE *Make-up water is domestic cold water used for regeneration activities.*

- [6] **IF** T-204 requires make-up water,
THEN:

- [A] Close HVA-204, Regenerant Effluent to T-204.
- [B] Ensure HVC-204 is OPEN
- [C] Open V-204, Influent Makeup Water by placing the V-204 switch to OPEN.

The V-204 switch is on the MCP 891 Main Control Panel.

7.1 IX Regeneration Operation—Automatic (continued)

Operator (continued)

- [7] **WHEN** make-up water is being added,
AND T-204 is filled,
THEN place the V-204 switch to CLOSED.

- [8] Ensure HVA-204 and HVB-204 are OPEN.

- [9] Ensure that breaker UCP-3 is ON.

Breaker UCP-3 is on the west wall of the control room.

- [10] Place the IX Control Panel I/O Power switch to ON.

The IX Control Panel I/O Power switch is on the east wall.

- [11] Ensure that the IX Auto and the IX Hand switches are OFF.

The IX Auto and the IX Hand switches are under the Allen Bradley touch screen.

- [12] Place the Operation Mode switch to PB-AUTO SEQ.

The Operation Mode switch is on the UCP3 Ion Exchange Control Panel .

- [13] Place the acid/caustic Di/Neut switch to DI.

- [14] Place the Man Regen Select switch to CHEM REGEN.

- [15] Place the following pump control switches to AUTO:

- P-3, Clean Water Pump
- P-4, Acid Pump
- P-5, Caustic Pump

- [16] Place the following switches to OFF:

- P-1, IX Feed
- P-2, Degas Forwarding Pump
- BLR-1
- BLR-2
- HTR-1

NOTE *Regeneration progress is indicated on the Regeneration Step Counter on UCP3 Ion Exchanger Control Panel.*

7.1 IX Regeneration Operation—Automatic (continued)

Operator (continued)

- [17] Start the automatic regeneration by pressing the START/ADVANCE REGENERATION pushbutton.

The system advances automatically through each step.

NOTE *The flows in Step [17] are monitored at the rotameter between P-4 and P-5 or at the rotameter at P-3.*

- [18] Monitor the flows and step durations during the regeneration cycles.

- [19] Adjust the flows in accordance with the table mounted adjacent to the IX Control Panel (flow tolerance ± 3 gpm):

[A] At P-3 using V-16

[B] At P-4 using V-66

[C] At P-5 using V-65

WARNING

Acid and caustic solutions sampled in the following steps present serious personnel hazards.

- [20] Don additional personal protective equipment in accordance with the Rocky Flats Plant Operable Unit 1 Groundwater Treatment Facility Health and Safety Plan.

- [21] During Step 3 of Appendix 4, collect a sample of the acid regenerant, 6% HCl, in a graduated cylinder from V-38, P-4 Acid Sample Port.

V-38 is above the pump at the discharge end of P-4.

NOTE *Step [22] may be performed at any time before step [27]*

- [22] Measure the specific gravity of the acid regenerant, 6% HCl, using the hydrometer provided, and record the results in the Daily Log.

- [23] Neutralize the sample and dispose in the building sump.

[A] Pour the sample into a bucket.

[B] Add dry neutralizer.

7.1 IX Regeneration Operation—Automatic (continued)

Operator (continued)

- [C] Wait until the foaming ceases.
- [D] Dispose contents of the bucket in building sump.
- [24] **IF** the specific gravity of the 6% HCl is **NOT** 1.0279,
THEN adjust the stroke of P-4.

The speed adjustment dial is on the pump.
- [25] **IF** the specific gravity of the 6% HCl is less than 1.0279,
THEN increase the stroke.
- [26] **IF** the specific gravity of the 6% HCl is greater than 1.0279,
THEN decrease the stroke.
- [27] Repeat steps [21] through [25] until the specific gravity of the 6% HCl is 1.0279
(1.0274 - 1.0284)
- [28] Prior to Step [29] don additional personal protective equipment in accordance with the
Rocky Flats Plant Operable Unit 1 Groundwater Treatment Facility Health and Safety
Plan.
- [29] During Step 9 of Appendix 4 collect a sample of the caustic in a graduated cylinder from
V-37, P-5 Sample Port.

V-37 is above the pump at the discharge end of P-5.

NOTE Step [30] may be performed at any time before step [34]

- [30] Measure the specific gravity of the caustic regenerant, 4% NaOH, using the hydrometer
provided, and record the results in the Daily Log.
- [31] Neutralize the sample and dispose in building sump.
 - [A] Pour the sample into a bucket.
 - [B] Add the dry neutralizer.
 - [C] Wait until the foaming ceases.
 - [D] Dispose the contents of the bucket in building sump.

7.1 IX Regeneration Operation—Automatic (continued)

Operator (continued)

[32] **IF** the specific gravity of the 4% NaOH is less than 1.0428,
THEN turn up the speed of P-5.

[33] **IF** the specific gravity of the 4% NaOH is greater than 1.0428,
THEN turn down the speed of P-5.

[34] Repeat Steps [29] through [33] until the specific gravity of the 4% NaOH is 1.0428
(1.0423 - 1.0433).

NOTE 1 *Refer to Step 17, Rinse to Quality of Appendix 4. If the rinse water obtained is not within specification for pH and conductivity in IX-2, IX-3, and IX-4 before the time counter times out, approximately 15 min., an alarm sounds and the system automatically shuts down.*

NOTE 2 *Conditions that cause water quality alarms are pre-programmed and appear as lights on the I/O power System Panel. The operator cannot observe or change the setpoints.*

[35] **IF** the alarm sounds,
THEN:

[A] Silence the alarm by pressing the ALARM SILENCE pushbutton on the UCP3 Ion Exchange Control Panel.

[B] Place the Operating Mode selector to MAN. RINSE.

This reinitiates Step 17 of Appendix 4. The system remains in Step 17 until rinse water meets specifications, then the system returns to the service or shutdown modes.

[C] **WHEN** the manual rinse is completed, as indicated by alarm clearing,
THEN place the Operating Mode selector to PB AUTO SEQ.

[36] **IF** any condition other than conductivity or pH alarms on the IX Control Panel,
THEN shut down the system by positioning switches P-3, P-4, and P-5 in OFF and notify the Project Manager.

[37] **WHEN** Step 17 of Appendix 4 is complete,
THEN place the following pumps to OFF:

- P-3
- P-4
- P-5

7.1 IX Regeneration Operation—Automatic (continued)

Operator (continued)

[38] **IF** the IX system is to be returned to automatic operation for treatment,
THEN:

[A] Place the acid/caustic Di/Neut Switch to DI.

[B] Go to 4-I52-ENV-OPS-FO.34, Ion Exchange System Normal Operations, Operable Unit 1, Building 891.

[39] **IF** the IX system is to be left in a shutdown configuration,
THEN place the UCP3 Ion Exchange Control Panel I/O Power switch to OFF.

7.2 IX Regeneration Operation—Manual

Project Manager and Operator

[1] Document all activities on the Daily Log in accordance with 2-G18-ER-ADM-17.01, Records Capture and Transmittal.

Project Manager

[2] Verify that all prerequisites in Section 6, Prerequisites have been completed, and record on Daily Log.

Operator

[3] Verify that T-210 is empty before starting regeneration.

[A] Observe the indicated level on the Allen Bradley screen.

[B] Observe the level in tank sightglass.

[4] Ensure that water level for T-204 is approximately 6 feet.

[A] Observe indicated level on Allen Bradley screen.

7.2 IX Regeneration Operation—Manual (continued)

NOTE Appendix 5, Valve Positioning may be used as a check sheet for the following step.

Operator (continued)

[5] Ensure that the following valves are OPEN:

- V-18, IX-1 Subsurface Backwash Inlet
- V-17, IX-2 Subsurface Backwash Inlet
- V-23, Caustic Makeup Water
- V-24, Acid Makeup Water
- V-15, P-3 Inlet
- V-16, P-3 Outlet
- V-19, IX-3 Subsurface Backwash Inlet
- V-20, IX-4 Subsurface Backwash Inlet
- V-21, Bag Filter #2 Inlet
- V-22, Bag Filter #2 Outlet
- V-27, P-5 Service Outlet
- V-28, P-4 Service Outlet
- V-29, P-5 Service Inlet
- V-30, P-4 Service Inlet
- V-31, T-208 Outlet
- V-32, T-209 Outlet
- V-47, IX-2 Acid Regenerant
- V-48, IX-3 Acid Regenerant
- V-49, IX-4 Caustic Regenerant
- V-65, Caustic Dilution Water Flow Control
- V-66, Acid Dilution Water Flow Control
- V-67, Caustic Pressure
- V-68, Acid Pressure

“FV” valves shown in Appendix 5 open and close automatically in each step.

[6] **IF** T-204 requires make-up water,
THEN:

[A] Close HVA-204, Regenerant Effluent to T-204

[B] Ensure HVC-204, Regeneration Clean Water to P-3 is OPEN

[C] Open V-204, Influent Makeup Water by placing the V-204 switch to OPEN.

The V-204 switch is on the MCP 891 Main Control Panel.

[7] **WHEN** make-up water is being added,
AND T-204 is filled,
THEN place the V-204 switch to CLOSED.

7.2 IX Regeneration Operation—Manual (continued)

Operator (continued)

[8] Open HVA-204.

[9] Ensure HVB-204 and HVC-204 are Open.

[10] Verify that Breaker UCP-3 is ON.

Breaker UCP-3 is on the west wall of the control room.

[11] Place the IX Control Panel I/O Power switch to ON.

The IX Control Panel I/O Power switch is on the east wall.

[12] Place the Operation Mode switch to PB-AUTO SEQ.

The Operation Mode switch is on the UCP3 Ion Exchange Control Panel.

[13] Place the Acid/Caustic Di/Neut Select switch to DI.

[14] Place the Man Regen switch to CHEM REGEN.

[15] Place the following Pump Control switches to AUTO:

- P-3
- P-4
- P-5

[16] Place the following switches to OFF:

- P-1
- P-2
- BLR-1
- BLR-2
- HTR-1

[17] Start the manual regeneration by pressing the START/ADVANCE REGENERATION pushbutton.

[18] Place the Operation Mode switch to MAN. STEP, and advance to the desired step.

[19] Press the START/ADVANCE REGENERATION pushbutton until an audible click is heard to advance to each successive step.

The regeneration step counter in the far right IX panel indicates the current step is in progress.

7.2 IX Regeneration Operation—Manual (continued)

Operator (continued)

[20] IF AUTO SEQUENCE is to be used,
THEN place the Operation Mode switch to PB AUTO SEQ.

[21] Monitor the flows and step durations during the regeneration cycles.

NOTE *Flows are monitored at the rotameter between P-4 and P-5 or at the rotameter at P-3.*

[22] Adjust the flows, as necessary:

[A] At P-3 using V-16.

[B] At P-4 using V-66.

[C] At P-5 using V-65.

WARNING

Acid and caustic solutions sampled in the following steps present serious personnel hazards.

[23] Don additional personal protective equipment in accordance with the Rocky Flats Plant Operable Unit 1 Groundwater Treatment Facility Health and Safety Plan.

[24] During Step 3 of Appendix 4, collect a sample of the acid in a graduated cylinder from V-38, P-4 Acid Sample Port.

V-38 is above the pump at the discharge end of P-4.

[25] Measure the specific gravity of the acid regenerant, 6% HCl, using the hydrometer provided and record the results in Daily Log.

NOTE *Step[26] may be performed at any time before step [31]*

[26] Neutralize and dispose of the sample in building sump.

[A] Pour the sample into the bucket.

[B] Add the dry neutralizer.

[C] Wait until the foaming ceases.

[D] Dispose of the contents of the bucket in building sump.

7.2 IX Regeneration Operation—Manual (continued)

Operator (continued)

- [27] **IF** the specific gravity of the 6% HCl is **NOT** 1.0279 (1.0274 - 1.0284)
THEN adjust the stroke of P-4.

The stroke adjustment dial is on the pump.

- [28] **IF** the specific gravity of the 6% HCl is less than 1.0279,
THEN increase the stroke.

- [29] **IF** the specific gravity of the 6% HCl is greater than 1.0279,
THEN decrease the stroke.

- [30] Repeat Step [25] through [29] until the specific gravity of the 6% HCl is 1.0279 (1.0274 - 1.0284) .

- [31] Don additional personal protective equipment in accordance with the Rocky Flats Plant Operable Unit 1 Groundwater Treatment Facility Health and Safety Plan.

- [32] During Step 9 of Appendix 4 collect a sample of the caustic in a graduated cylinder from V-37, P-5 Sample Port.

V-37 is above the pump at the discharge end of P-5.

- [33] Measure the specific gravity of the caustic regenerant, 4% NaOH, using the hydrometer provided and record the results in the Daily Log.

NOTE *Step [34] may be performed at any time before step [38]*

- [34] Neutralize the sample and dispose in building sump.

[A] Pour the sample into the bucket.

[B] Add the dry neutralizer.

[C] Wait until the foaming ceases.

[D] Dispose of the contents of the bucket in building sump.

- [35] **IF** the specific gravity of the 4% NaOH is less than 1.0428,
THEN increase the speed.

- [36] **IF** the specific gravity of the 4% NaOH is greater than 1.0428,
THEN decrease the speed.

7.2 IX Regeneration Operation—Manual (continued)

Operator (continued)

- [37] Repeat Step [32] through [36] until the specific gravity of the 4% NaOH is 1.0428 (1.0423 - 1.0433).

NOTE *Refer to Step 17, Rinse to Quality of Appendix 4. If the rinse water obtained is not within specification for pH and conductivity in IX-2, IX-3, and IX-4 before the time counter times out, in approximately 15 min, an alarm sounds, and the system automatically shuts down.*

NOTE 2 *Conditions that cause water quality alarms are pre-programmed and appear as lights on the I/O power System Panel. The operator cannot observe or change the set points.*

- [38] **IF** the alarm sounds,
THEN:

[A] Silence the alarm by pressing the ALARM SILENCE pushbutton on UCP3 Ion Exchange Control Panel.

[B] Manually rinse the system until the rinse water is within specification.

[a] Place the Operating Mode selector to MAN. RINSE.

This reinitiates Step 17 of Appendix 4. The system remains in Step 17 until rinse water meets specifications, and then the system returns to the service or shutdown modes.

[C] Place the Operating Mode selector to PB AUTO SEQ.

- [39] **IF** any condition other than conductivity or pH alarms on the IX Control Panel,
THEN shut down the system by positioning switches P-3, P-4, and P-5 in OFF.

[A] Notify Project Manager.

- [40] **WHEN** Step 17 of the regeneration is complete,
THEN place the following pumps to OFF:

- P-3
- P-4
- P-5

- [41] **IF** the IX system is to be returned to automatic operation for treatment,
THEN:

7.2 IX Regeneration Operation—Manual (continued)

Operator (continued)

- [A] Ensure that the Acid/Caustic Di/Neut switch is in the DI position.
- [B] Go to 4-I52-ENV-OPS-FO.34, Ion Exchange System Normal Operations, Operable Unit 1, Building 891.
- [42] **IF** the IX system is to be left in a shut down configuration,
THEN place the IX Control Panel I/O Power switch in OFF.

8. RECORDS

Management of all records is consistent with 1-77000-RM-001, Records Management Guidance for Records Sources.

Project Manager

- [1] Ensure that the original and one copy, as required, of the following quality assurance (QA) records are transmitted to the ERPD Project File Center (PFC) in accordance with 2-G18-ER-ADM-17.01, Records Capture and Transmittal:
 - Daily Log

Submission of record copies to the ERPD PFC is in accordance with Administrative Record requirements, as defined in 2-S65-ER-ADM-17.02, Administrative Record Document Identification and Transmittal.

There are no non-QA records generated by this procedure.

9. REFERENCES

Bruner Ion Exchange Manual

Rocky Flats Plant Operable Unit 1 Groundwater Treatment Facility Health and Safety Plan

1-77000-RM-001, Records Management Guidance for Records Sources.

2-F94-ER-ADM-02.01, Training

2-G18-ER-ADM-17.01, Records Capture and Transmittal.

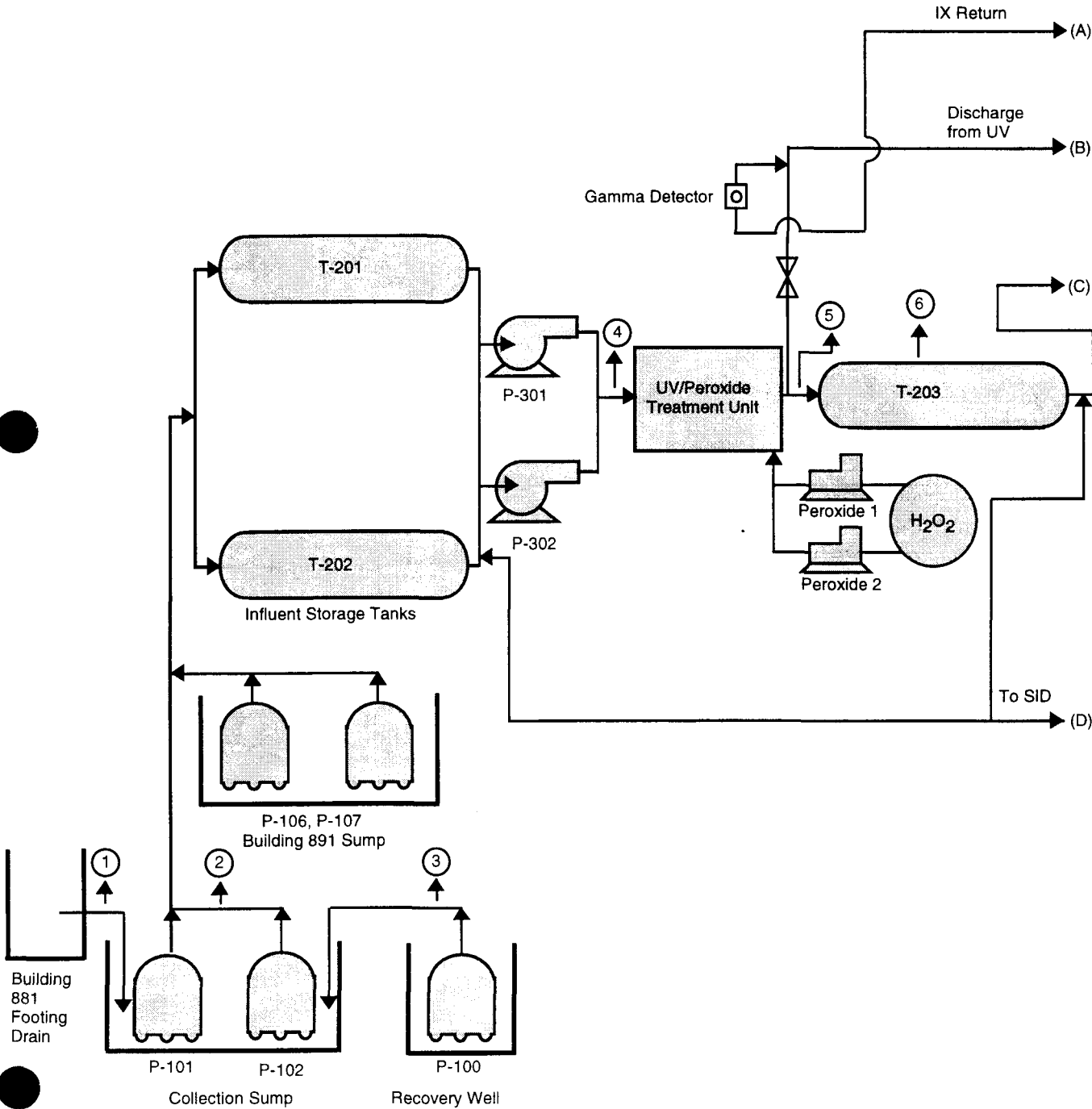
2-S65-ER-ADM-17.02, Administrative Record Document Identification and Transmittal

4-I52-ENV-OPS-FO.34, Ion Exchange System Normal Operations, Operable Unit 1, Building 891

APPENDIX 1

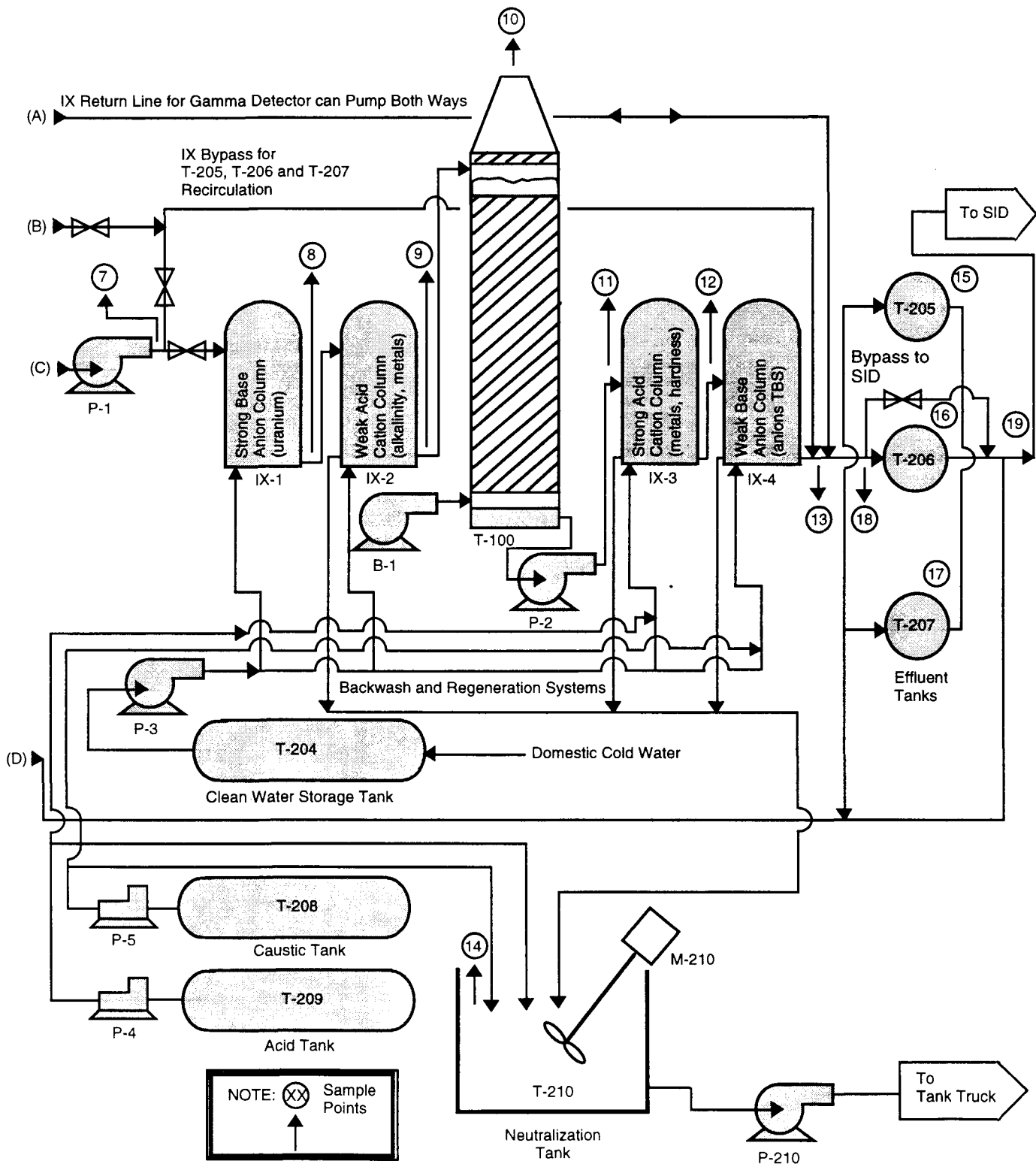
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GROUNDWATER RECOVERY/STORAGE SYSTEM DIAGRAM



APPENDIX 1

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APPENDIX 2

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VALVES

VALVE NO.	DESCRIPTION	TYPE
V-1	P-1 Service Inlet	2-in. Ball
V-2	P-1 Service Outlet	2-in. Ball
V-3	Bag Filter Outlet	2-in. Ball
V-4	IX-1 Inlet Isolation	1 1/2-in. Ball
V-5	IX-1 Outlet Isolation	1 1/2-in. Ball
V-6	IX-2 Inlet Isolation	1 1/2-in. Ball
V-7	IX-2 Outlet Isolation	1 1/2-in. Ball
V-8	Degasifier Inlet Isolation	1 1/2-in. Ball
V-9	Degasifier Outlet/P-2 Inlet	1 1/2-in. Ball
V-10	P-2 Outlet	1 1/2-in. Ball
V-11	IX-3 Inlet Isolation	1 1/2-in. Ball
V-12	IX-3 Outlet Isolation	1 1/2-in. Ball
V-13	IX-4 Inlet Isolation	1 1/2-in. Ball
V-14	UV #2 Sample Port	1/2-in. Ball
V-15	P-3 Inlet	2-in. Ball
V-16	P-3 Outlet	3-in. Ball
V-17	IX-2 Subsurface Backwash Inlet	2-in. Ball
V-18	IX-1 Subsurface Backwash Inlet	2-in. Ball
V-19	IX-3 Subsurface Backwash Inlet	2-in. Ball
V-20	IX-4 Subsurface Backwash Inlet	2-in. Ball
V-21	Bag Filter #2 Inlet	2-in. Ball
V-22	Bag Filter #2 Outlet	2-in. Ball
V-23	Caustic Makeup Water	1-in. Ball
V-24	Acid Makeup Water	1-in. Ball
V-25	P-5 to T-210 Influent	1 1/2-in. Ball
V-26	P-4 to T-210 Influent	1 1/2-in. Ball
V-27	P-5 Service Outlet	3/4-in. Ball
V-28	P-4 Service Outlet	3/4-in. Ball
V-29	P-5 Service Inlet	3/4-in. Ball
V-30	P-4 Service Inlet	1-in. Ball
V-31	T-208 Outlet	3/4-in. Ball
V-32	T-209 Outlet	1-in. Ball
V-33	BLR-2 Outlet	1 1/2-in. Ball
V-34	Degasifier Drain	1-in. Ball
V-35	Bag Filter 2 Drain	1/2-in. Ball

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VALVE NO.	DESCRIPTION	TYPE
V-36	Bag Filter 1 Drain	1/2-in. Ball
V-37	P-5 Caustic Sample Port	1/4-in. Ball
V-38	P-4 Acid Sample Port	1/4-in. Ball
V-39	IX-2 Effluent Sample Port	3/4-in. Ball
V-40	IX-1 Effluent Sample Port	3/4-in. Ball
V-41	IX-3 Sample Port	3/4-in. Ball
V-42	IX-4 Sample Port	3/4-in. Ball
V-43	IX-2 Vent	3/4-in. Ball
V-44	IX-1 Vent	3/4-in. Ball
V-45	IX-3 Vent	3/4-in. Ball
V-46	IX-4 Vent	3/4-in. Ball
V-47	IX-2 Acid Regenerant	1 1/2-in. Ball
V-48	IX-3 Acid Regenerant	1 1/2-in. Ball
V-49	IX-4 Caustic Regenerant	1 1/2-in. Ball
V-50	P-100 Outlet	1 1/2-in. Ball
V-51	P-101 Outlet	1-in. Ball
V-52	P-102 Outlet	1-in. Ball
V-53	Collection Gallery Filter Inlet	2-in. Ball
V-54	Collection Gallery Filter Bypass	2-in. Ball
V-55	Collection Gallery Filter Outlet	2-in. Ball
V-56	P-101, P102 Effluent	2-in. Ball
V-57	T-201, T-202 Influent	2-in. Ball
V-58	Domestic Influent Backflow Preventor	2-in. Ball
V-59	Domestic Influent Backflow Preventor	2-in. Ball
V-61	T-201 Secondary Containment Purge	2-in. Ball
V-62	T-202 Secondary Containment Purge	2-in. Ball
V-63	UV Influent T-201, T-202 Secondary Containment Purge	2-in. Ball
V-64	UV Influent T-201 Secondary Containment Purge	2-in. Ball
V-65	Caustic Dilution Water Flow Control	3/4-in. Gate
V-66	Acid Dilution Water Flow Control	3/4-in. Gate
V-67	Caustic Pressure	2-in. Ball
V-68	Acid Pressure	2-in. Ball
V-69	UV Effluent T-203 Secondary Containment Purge	2-in. Ball
V-70	T-204 Secondary Containment Purge	2-in. Ball
V-71	Chemical Metering Isolation	3/4-in. Ball
V-72	Chemical Metering Isolation	3/4-in. Ball
V-73	T-201 and T-202 Secondary Containment Purge	2-in. Ball

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VALVE NO.	DESCRIPTION	TYPE
V-74	UV Effluent Camlock	2-in. Ball
V-75	UV Basket Strainer Influent	2-in. Ball
V-76	Basket Strainer Camlock	2-in. Ball
V-77	P-301, P-302 Effluent Camlock	2-in. Ball
V-78	UV Influent Sample Port	1/2-in. Ball
V-79	UV #1 Effluent Sample Port	1/2-in. Ball
V-80	Gamma Detection Isolation	2-in. Ball
V-81	H ₂ O ₂ Tank Sample Port	1/2-in. Ball
V-82	H ₂ O ₂ Outlet	1/4-in. Ball
V-83	Chemical Metering Isolation	3/4-in. Ball
V-84	H ₂ O ₂ P-1 Influent	1/4-in. Ball
V-85	H ₂ O ₂ P-2 Influent	1/4-in. Ball
V-86	T-209 Influent Line Sample Port	1/4-in. Ball
V-87	T-208 Influent Line Sample Port	1/4-in. Ball
V-88	H ₂ O ₂ P-1 Effluent	1/4-in. Ball
V-89	Air Scour Unloader	1 1/2-in. Butterfly
V-90	H ₂ O ₂ P-2 Effluent	1/4-in. Ball
V-91	H ₂ O ₂ Splitter Pump Influent	1/2-in. Ball
V-92	Splitter Pump Purge	1/2-in. Ball
V-93	UV Chamber #1 Effluent Pressure	1/2-in. Ball
V-94	IX-4 Effluent	1 1/2-in. Ball
V-95	Plant Effluent	2-in. Ball
V-96	Plant Effluent Sample Port	1-in. Ball
V-97	T-210 Purge Port	1/2-in. Ball
V-98	T-210 Sightglass	2-in. Ball
V-99	P-210 Effluent Isolation	2-in. Ball
V-100	P-210 Discharge Isolation	2-in. Ball
V-101	T-210 Effluent Bypass	2-in. Ball
V-102	Influent Secondary Containment Purge	2-in. Ball
V-103	Truck Dock Influent	2-in. Ball
V-104	Truck Dock Influent Secondary Containment Purge	2-in. Ball
V-105	Influent Line Secondary Containment Purge	2-in. Ball
V-106	Effluent Tank Bypass (underground)	N/A
V-107	UV #1 Drain	1/2-in. Ball
V-108	Recirculation Isolation	2-in. Ball
V-109	UV #2 Drain	1/2-in. Ball
V-110	Makeup Water	2-in. Ball

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VALVE NO.	DESCRIPTION	TYPE
V-111	Inlet H ₂ O ₂ Rotameter 1	1/2-in. Gate
V-112	Inlet H ₂ O ₂ Rotameter 2	1/2-in. Gate
V-113	Inlet H ₂ O ₂ Rotameter 3	1/2-in. Gate
V-114	Outlet H ₂ O ₂ Rotameter 1	1/2-in. Ball
V-115	Outlet H ₂ O ₂ Rotameter 2	1/2-in. Ball
V-116	Outlet H ₂ O ₂ Rotameter 3	1/2-in. Ball
V-117	T-210 Recirculation Isolation	2-in. Ball
V-118	IX Feed Camlock	2-in. Ball
V-119	PSIG IX-1 Purge	1/4-in. Ball
V-120	PSIG IX-2 Purge	1/4-in. Ball
V-121	PSIG IX-2 Purge (no gauge)	1/4-in. Ball
V-122	PSID IX-2 Purge	1/4-in. Ball
V-123	PSID IX-3 Purge	1/4-in. Ball
V-124	PSIG IX-3 Purge	1/4-in. Ball
V-125	PSIG IX-4 Purge	1/4-in. Ball
V-126	PSIG UV #1	1/2-in. Ball
V-127	PSIG UV #2	1/2-in. Ball
V-128	Gamma Detection Isolation	2-in. Ball
V-129	Recirculation Purge	1-in. Ball
V-130	IX-2 Effluent Isolation	2-in. Ball
V-131	IX-4 Effluent Isolation	2-in. Ball
V-132	T-204 Clean Water Line Sample Port	1/4-in. Sample Cock
HV-107	Sump Pump Discharge	2-in. Ball
HV-108	Sump Pump Discharge	2-in. Ball
HV-500	Recirculation From Effluent Storage Tanks	2-in. Ball
HV-501	Recirculation to UV	2-in. Ball
HV-502	Recirculation to IX	2-in. Ball
HV-503	Recirculation	2-in. Ball
FV-7	Dilute Acid for T-210 Neutralization	1 1/2-in. Auto
FV-9	Acid Regenerant	1 1/2-in. Auto
FV-17	Dilute Caustic for T-210 Neutralization	1 1/2-in. Auto
FV-19	Caustic Regenerant	1 1/2-in. Auto
FV-1A	IX-1 Service Inlet	1 1/2-in. Auto
FV-2A	IX-1 Backwash Inlet	1 1/2-in. Auto
FV-5A	IX-4 Backwash Outlet	1 1/2-in. Auto
FV-8A	IX-1 Fast Rinse Inlet	2-in. Auto

APPENDIX 2

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VALVE NO.	DESCRIPTION	TYPE
FV-10A	IX-1 Fast Rinse Outlet	2-in. Auto
FV-11A	IX-1 Air Scour Inlet	1 1/2-in. Auto
FV-12A	IX-1 Subsurface Wash Inlet	1 1/2-in. Auto
FV-13A	IX-1 Air Scour Outlet	1-in. Auto
FV-1B	IX-1 Outlet/IX-2 Service Inlet	1 1/2-in. Auto
FV-2B	IX-2 Backwash Inlet	1 1/2-in. Auto
FV-3B	IX-2 Acid Regenerant/Settler Rinse Inlet	1 1/2-in. Auto
FV-4B	IX-2 Outlet	1 1/2-in. Auto
FV-5B	IX-2 Backwash Outlet	1 1/2-in. Auto
FV-6B	IX-2 Spent Regenerant Outlet	1 1/2-in. Auto
FV-8B	IX-2 Fast Rinse Inlet	2-in. Auto
FV-10B	IX-2 Fast Rinse Outlet	2-in. Auto
FV-11B	IX-2 Air Scour Inlet	1 1/2-in. Auto
FV-12B	IX-2 Subsurface Wash Inlet	1 1/2-in. Auto
FV-13B	IX- Air Scour Outlet	1-in. Auto
FV-1C	IX-2 Service Outlet/IX-3 Service Inlet	1 1/2-in. Auto
FV-2C	IX-3 Backwash Inlet	1 1/2-in. Auto
FV-3C	IX-3 Acid Regenerant/Settler Rinse Inlet	1 1/2-in. Auto
FV-5C	IX-3 Backwash Outlet	1 1/2-in. Auto
FV-6C	IX-3 Spent Regenerant Outlet	1 1/2-in. Auto
FV-8C	IX-3 Fast Rinse Inlet	2-in. Auto
FV-10C	IX-3 Fast Rinse Outlet	2-in. Auto
FV-11C	IX-3 Air Scour Inlet	1 1/2-in. Auto
FV-12C	IX-3 Subsurface Wash Inlet	1 1/2-in. Auto
FV-13C	IX-3 Air Scour Outlet	1-in. Auto
FV-1D	IX-3 Service Outlet/IX-4 Service Inlet	1 1/2-in. Auto
FV-2D	IX-4 Backwash Inlet	1 1/2-in. Auto
FV-3D	IX-4 Caustic Regenerant/Settler Rinse Inlet	1 1/2-in. Auto
FV-4D	IX-4 Service Outlet	1 1/2-in. Auto
FV-5D	IX-4 Backwash Outlet	1 1/2-in. Auto
FV-6D	IX-4 Spent Regenerant Outlet	1 1/2-in. Auto
FV-8D	IX-4 Fast Rinse Inlet	2-in. Auto
FV-10D	IX-4 Fast Rinse Outlet	2-in. Auto
FV-11D	IX-4 Air Scour Inlet	1 1/2-in. Auto
FV-12D	IX-4 Subsurface Wash Inlet	1 1/2-in. Auto

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VALVE NO.	DESCRIPTION	TYPE
FV-13D	IX-4 Air Scour Outlet	1-in. Auto
HVA-201	Influent from French Drain to T-201	2-in. Ball
HVB-201	Effluent From T-201	2-in. Ball
HVA-202	Influent from French Drain to T-202	2-in. Ball
HVA-202	Effluent From T-202	2-in. Ball
HVA-203	UV Effluent to T-203	2-in. Ball
HVB-203	IX Feed From T-203	2-in. Ball
HVA-204	Regenerant Effluent to T-204	2-in. Ball
HVB-204	Regeneration Clean Water From RFP	2-in. Ball
HVC-204	Regeneration Clean Water to P-3	2-in. Ball
HVA-205	Plant Effluent/T-205 Influent	2-in. Ball
HVB-205	T-205 Discharge	4-in. Butterfly
HVC-205	T-205 Recirculation	4-in. Butterfly
HVA-206	Plant Effluent/T-206 Influent	2-in. Ball
HVB-206	T-206 Discharge	4-in. Butterfly
HVC-206	T-206 Recirculation	4-in. Butterfly
HVA-207	Plant Effluent/T-207 Influent	2-in. Ball
HVB-207	T-207 Discharge	4-in. Butterfly
HVC-207	T-207 Recirculation	4-in. Butterfly
HVD-207	T-207 Isolation	2-in. Ball
HVA-208	Caustic Inlet-Truck Dock	2-in. Ball
HVB-208	Caustic Outlet-T-208	2-in. Ball
HVA-209	Acid Inlet-Truck Dock	2-in. Ball
HVB-209	Acid Outlet-T-209	2-in. Ball
HVA-210	P-210 Inlet	2-in. Ball
HVB-210	P-210 Outlet	2-in. Ball
HVC-210	Discharge Camlock	2-in. Ball
HVD-210	Discharge Truck Dock	2-in. Ball
HVA-301	P-301 Inlet	2-in. Ball
HVB-301	P-301 Outlet	2-in. Ball
HVA-302	P-302 Inlet	2-in. Ball
HVB-302	P-302 Outlet	2-in. Ball
FCV-1	Fail Close Plant Effluent	1 1/2-in. Solenoid
FCV-2	Fail Close Recycle	2-in. Diaphragm
FCV-3	Collection Gallery Flow Control	2-in. Diaphragm
FCV-4	UV Effluent Control	1 1/2-in. Ball
V-204	Influent Makeup Water	2-in Solenoid

APPENDIX 3

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REGENERATION SCHEDULE

Regen Step ^a	Description Location	Concentration Resin Quantity (cf)	Total Cycle Time (min)	Water Flow (gpm)	Chemical Flow (gpm)	Waste Volume (gal)	EFFL ^b Tank
1	IX-3 backwash	56	10	60	-	600	204
2	IX-2 backwash	32	10	30	-	300	204
3	IX-3 acid inj	56	16	21	4.5	408	210
4	IX-3&2 acid inj	56-32	11	21	4.5	280.5	210
5	IX-3&2 displ rinse	56-32	34	21	-	714	210
6	IX-3 fast rinse	56	22	84	-	1818	204
7	IX-2 fast rinse	32	16	60	-	960	204
8	IX-4 backwash	56	10	40	-	400	204
9	IX-4 caustic inj	56	30	26	1.5	825	210
10	IX-4 displ rinse	56	35	26	-	1225	210
11	IX-4 fast rinse	56	20	84	-	1680	204
12	IX-1 subsurf wash	28	10	30	-	300	204
13	IX-1 back bump	28	.3	30	-	9	204
14	IX-1 settle/rinse	28	1.0	30	-	30	204
15	IX-1 back bump	28	.3	30	-	9	204
16	IX-1 settle/rinse	28	0.3	30	-	9	204
17	IX-1 rinse to quality	28-32-56-56	10	45	-	450	204
Totals			239			10128.5	
Totals	-T-204 (every fifth regeneration with IX-1)					6,676	
Totals	-T-210					3,452.5	
Totals	-T-204 exclusive of IX-1 wash Cycle steps 12 through 16 (6,676 through 438)						

^aRegeneration flow rates and waste volumes are approximate and are subject to field adjustment for optimum performance.

^bT-204 is the Clean Water Tank
T-210 is the Neutralization Tank

Notes: Initial service run between regenerations is 64,800 gallons.
Initial service run between regenerations is 57,600 gallons.

APPENDIX 4

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DETAILED REGENERATION SCHEDULE

-
- | | |
|---------|--|
| Step 1 | IX-3 backwash 60 gpm, valves opened FV-2C + FV-5C, 10 minutes. |
| Step 2 | IX-2 backwash 30 gpm, valves opened FV-2B + FV-5B, 10 minutes. |
| Step 3 | IX-3 acid injection 25.5 gpm, valves opened FV-9, FV-3C & FV-6C + 6% HCL specific gravity 1.0279, 16 minutes. |
| Step 4 | IX-3 + IX-2 acid injection, 25.5 gpm, valves opened FV-9, FV-3C, FV-3B & FV-6B + 6% HCL specific gravity 1.0279, 11 minutes. |
| Step 5 | IX-3 displacement rinse 21 gpm, valves opened FV-3C, FV-3B + FV-6B, 34 minutes |
| Step 6 | IX-3 fast rinse 84 gpm, valves opened FV-8C + FV-10C, 22 minutes. |
| Step 7 | IX-2 fast rinse 60 gpm, valves opened FV-8B + FV-10B, 16 minutes. |
| Step 8 | IX-4 backwash 40 gpm, valves opened FV-2D + FV-5D, 10 minutes. |
| Step 9 | IX-4 caustic injection 27.5 gpm, valves opened FV-19, FV-3D & FV-6D + 6% NaOH specific gravity 1.0428, 30 minutes. |
| Step 10 | IX-4 displacement rinse 26 gpm, valves opened FV-3D + FV-6D, 35 minutes. |
| Step 11 | IX-4 fast rinse 84 gpm, valves opened, FV-8D + FV-10D, 20 minutes. |
| Step 12 | IX-1 subsurface wash 30 gpm, valves opened FV-12A + FV-5A, 10 minutes. |
| Step 13 | IX-1 backwash bump 30 gpm, valves opened FV-2A + FV-5A, 0.3 minutes. |
| Step 14 | IX-1 settle rinse 30 gpm, valves opened, FV-8A + FV-10A, 1.0 minutes. |
| Step 15 | IX-1 backwash bump 30 gpm, valves opened FV-2A + FV-5A, 0.3 minutes. |
| Step 16 | IX-1 settle rinse 30 gpm, valves opened FV-8A + FV-10A, 0.3 minutes. |
| Step 17 | Rinse to quality 45 gpm, valves opened FV-1A, FV-4B, FV-1C, FV-1D + FV-10D, 1-15 minutes. |

APPENDIX 5

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VALVE POSITIONING

Valve Positioning for IX-1 Regeneration Operations

			Function
Valve No.	Subsurface Wash	Backwash Bump	Settle Rinse
FV-1A	C	C	C
FV-2A	C	O	C
FV-5A	O	O	C
FV-8A	C	C	O
FV-10A	C	C	O
FV-11A	C	C	C
FV-12A	O	C	C
FV-13A	C	C	C
V-15	O	O	O
V-16	O	O	O
V-17	O	O	O
V-18	O	O	O
V-19	O	O	O
V-20	O	O	O
V-21	O	O	O
V-22	O	O	O
V-23	O	O	O
V-24	O	O	O
V-27	O	O	O
V-28	O	O	O
V-29	O	O	O

Valve Positioning for IX-1 Regeneration Operations

			Function
Valve No.	Subsurface Wash	Backwash Bump	Settle Rinse
V-30	O	O	O
V-31	O	O	O
V-32	O	O	O
V-47	O	O	O
V-48	O	O	O
V-49	O	O	O
V-65	O	O	O
V-66	O	O	O
V-67	O	O	O
V-68	O	O	O

APPENDIX 5

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Valve Positioning for IX-2 Regeneration Operations

				Function
Valve No.	Backwash	Acid Injection	Displacement Rinse	Fast Rinse
FV-1B	C	C	C	C
FV-2B	O	C	C	C
FV-3B	C	O	O	C
FV-4B	C	C	C	C
FV-5B	O	C	C	C
FV-6B	C	O	O	C
FV-8B	C	C	C	O
FV-10B	C	C	C	O
FV-12B	C	C	C	C
FV-9	C	O	C	C
V-3C	C	O	O	C
V-15	O	O	O	O
V-16	O	O	O	O
V-17	O	O	O	O
V-18	O	O	O	O
V-19	O	O	O	O

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Valve Positioning for IX-2 Regeneration Operations

				Function
Valve No.	Backwash	Acid Injection	Displacement Rinse	Fast Rinse
V-30	O	O	O	O
V-31	O	O	O	O
V-32	O	O	O	O
V-47	O	O	O	O
V-48	O	O	O	O
V-49	O	O	O	O
V-65	O	O	O	O
V-66	O	O	O	O
V-67	O	O	O	O
V-68	O	O	O	O

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Valve Positioning for IX-3 Regeneration Operations

				Function
Valve No.	Backwash	Acid Injection	Displacement Rinse	Fast Rinse
FV-1C	C	C	C	C
FV-2C	O	C	C	C
FV-3C	C	C	O	C
FV-5C	O	C	C	C
FV-6C	C	O	C	C
FV-8C	C	C	C	C
FV-10C	C	C	C	O
FV-11C	C	C	C	O
FV-12C	C	C	C	C
FV-13C	C	C	C	C
FV-3B	C	O	O	C
FV-6B	C	O	O	C
FV-9	C	O	C	C
V-15	O	O	O	O
V-16	O	O	O	O
V-17	O	O	O	O
V-18	O	O	O	O
V-19	O	O	O	O

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Valve Positioning for IX-3 Regeneration Operations

				Function
Valve No.	Backwash	Acid Injection	Displacement Rinse	Fast Rinse
V-20	O	O	O	O
V-21	O	O	O	O
V-22	O	O	O	O
V-23	O	O	O	O
V-24	O	O	O	O
V-27	O	O	O	O
V-28	O	O	O	O
V-29	O	O	O	O
V-30	O	O	O	O
V-31	O	O	O	O
V-32	O	O	O	O
V-47	O	O	O	O
V-48	O	O	O	O
V-49	O	O	O	O
V-65	O	O	O	O
V-66	O	O	O	O
V-67	O	O	O	O
V-68	O	O	O	O

APPENDIX 5

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Valve Positioning for IX-4 Regeneration Operations

				Function
Valve No.	Backwash	Caustic Injection	Displacement Rinse	Fast Rinse
FV-1D	C	C	C	C
FV-2D	O	C	C	C
FV-3D	C	O	O	C
FV-4D	C	C	C	C
FV-5D	O	C	C	C
FV-6D	C	O	O	C
FV-8D	C	C	C	O
FV-16D	C	C	C	O
FV-11D	C	C	C	C
FV-12D	C	C	C	C
FV-13D	C	C	C	C
FV-19	C	O	C	C
V-15	O	O	O	O
V-16	O	O	O	O
V-17	O	O	O	O
V-18	O	O	O	O
V-19	O	O	O	O

APPENDIX 5

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Valve Positioning for IX-4 Regeneration Operations

				Function
Valve No.	Backwash	Caustic Injection	Displacement Rinse	Fast Rinse
V-20	O	O	O	O
V-21	O	O	O	O
V-22	O	O	O	O
V-23	O	O	O	O
V-24	O	O	O	O
V-27	O	O	O	O
V-28	O	O	O	O
V-29	O	O	O	O
V-30	O	O	O	O
V-31	O	O	O	O
V-32	O	O	O	O
V-47	O	O	O	O
V-48	O	O	O	O
V-49	O	O	O	O
V-65	O	O	O	O
V-66	O	O	O	O
V-67	O	O	O	O
V-68	O	O	O	O

APPENDIX 5

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Valve Positioning for IX-1, 2, 3, 4 Regeneration Operations

	Function
Valve No.	Rinse to Quality
FV-1A	O
FV-1B	O
FV-4B	O
FV-1C	O
FV-1D	O
FV-10D	O
V-15	O
V-16	O
V-17	O
V-18	O
V-19	O
V-20	O
V-21	O
V-22	O
V-23	O
V-24	O
V-27	O
V-28	O
V-29	O

APPENDIX 5

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Valve Positioning for IX-1, 2, 3, 4 Regeneration Operations

	Function
Valve No.	Rinse to Quality
V-30	O
V-31	O
V-32	O
V-47	O
V-48	O
V-49	O
V-65	O
V-66	O
V-67	O
V-68	O